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Case Report

Arteriovenous Fistula Stenosis: A Case Report

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ABSTRACT

Background: Arteriovenous fistula (AVF) has better rate of patency and lower rate of complication compared to other vascular access for hemodialysis. One priority to be concerned is access failure for hemodialysis access is common findings and correspond with high healthcare cost, morbidity and mortality.
Objective: This case report aimed to elaborate the proper management of patient with arterio fistula stenosis.
Case Illustration: A man, 64 years old, stage V CKD with AVF in his left arm for hemodialysis access was admitted to our hospital due to difficulty in cannulation during his last hemodialysis. He had AVF For Hemodialysis access for two years. About 1 month before, he undergone surgery for creation of AVF for hemodialysis access in his right arm, but AVF was failed to reach maturation. Based on vascular doppler ultrasound (DUS) done in AVF of the left arm revealed there was stenosis in the juxta-anastomosis site and cephalic venous stenosis. Angioplasty was done in anastomose AVF and implantation of venous stent in the left cephalic vein.
Conclusion: For patients on hemodialysis, vascular access is considered as the lifeline. Complications related to Vascular access is associated with morbidity and reduced quality of life. Surgery often difficult to do as readily as a percutaneous approach. In more than 80% of hemodialysis access underwent percutaneous interventions, flow was successfully restored. Based on this success rate, it has replaced surgical revision as the treatment of stenosis AVF.

1. Introduction

Complications related to vascular access is associated with morbidity and reduced quality of life. the main problem for patients undergoing hemodialysis is dysfunction of hemodialysis access. The common cause of this is venous stenosis. The site AVF tend to develop stenosis is at the juxta-anastomosis site and the outflow vein. The first line management of AVF stenosis is balloon angioplasty, with stent placement is only done is special circumstances.

2. Case Illustration

A 64 years old man with stage V CKD with AVF in his left arm for hemodialysis access was admitted to our hospital due to difficulty in cannulation during his last hemodialysis. He had AVF For Hemodialysis access since two years ago. About 1 month before, he undergone surgery for creation of AVF for hemodialysis access in his right arm, but AVF was failed to reach maturation. Based on vascular ultrasound done in AVF of the left arm revealed there was stenosis in the juxta-anastomosis site and cephalic venous stenosis. Angioplasty was done in anastomose AVF and implantation of venous stent in the left cephalic vein.

3. Discussion

3.1 Epidemiology

From 11th Indonesian Renal Registry 2018, patients with Stage 5 CKD show a consistent increase in the number of new and active patients.[1] Globally, in 2017, there were 697.5 million cases of CKD. In 2017, estimated prevalence of CKD was at 9·1% in the world's population.[2] It was approximated that the total CKD patients would be doubled from 2010 to 2030 will received Renal Replacement Therapy (RRT). Asia will have the largest growth in the number of patients receiving RRT rising from almost one million patients in 2010 to slightly over 2 million patients by 2030.

3.2 Dysfunction of arteriovenous access: Pathophysiology

There is intricate process that involved in the pathogenesis of

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Table 1. Routine AV Access Monitoring by Physical Examination.[10]

Exam steps	Fistula (Normal)	Graft (Normal)	Flow Related Dysfunction or poor Maturation (Abnormal)	Flow Related Dysfunction or poor Maturation (Abnormal)
look	Well-developed main venous outflow, no irregular/dilated areas or aneurysm formations, adequate areas of straight vein that can be used for 2-needle, rope-ladder cannulation Vessel collapses when arm is elevated above head	Uniform-sized graft in a loop or straight configuration No irregular areas or aneurysm or seroma formations with organized site rotation used for cannulation	AVF with poor maturation—multiple venous outflow veins (accessory veins), poorly defined cannulation areas **AVF:** Stenosis can occur in artery or any venous outflow vein Look for a narrowing of the outflow vein, abnormal pulsations, or aneurysm formations **AVF or AVG:** Dilated neck veins or surface collateral veins in the arm or neck above the vascular access	**Infection:** Redness, swelling, induration, drainage, or pus **Steal syndrome:** Extremity/hand discoloration, skin ulceration due to poor arterial blood flow to the hand Check nail beds, fingers and hand for unusual skin changes **Aneurysm** Abnormal areas of dilatation with overlying skin thinning
Listen with a stethoscope	Low-pitch continuous diastolic and systolic	Low-pitch continuous diastolic and systolic	High-pitch discontinuous systolic only	**Steal syndrome** AVF may have a very strong bruit
Feel with your finger	Thrill at the arterial anastomosis and throughout the entire outflow vein that is easy to compress	Thrill strongest at the arterial anastomosis but should be felt over entire graft and be easy to compress	**AVF:** Pulse at the site of a stenotic lesion—may be water-hammer in quality and feel **AVG:** Thrill and/or pulse strong at the site of stenotic lesion pulse has a water-hammer feel An AVG with a low intra-access blood flow feels mushy Local area of the graft that feels mushy or irregular in shape can be a site of aneurysm formation	**Infection** Warm or painful to touch, swelling **Steal syndrome** Feel bilateral limbs (hands and fingers) and compare for the access limb to be the same as the nonaccess limb Compare temperature, grip strength, and range of motion and any complaints of changes in sensation or pain If the access limb has any major differences than the nonaccess limb, consider steal syndrome

Note, Abbreviations: AVF, arteriovenous fistula; AVG, arteriovenous graft.

of vascular access dysfunction. The collective pathway is combination of neointimal hyperplasia, vascular remodeling inwardly, and impaired vessel vasodilation that has consequence of narrowing of the lumen and associated with formation of thrombosis. The most site in AVF failure is at the perianastomotic region. The pathophysiologic events leading to AVF failure was categorized into upstream events and downstream events.[6,7,8]

3.3 Diagnosing AVF Stenosis

The reasons for implementing vascular access monitor and surveillance routinely, are to find and repair AVF stenosis,.to improve AVF access function, to reduced or avert dampen dialysis clearance, and also to lower the rate of thrombosis. Physical examination is one of the clinical monitoring strategies that ideally done when the patient is not on dialysis. This requires minimal training, takes minimal equipment and time, is cost-efficient, and readily available. When performed by experienced medical staff, physical examination of vascular access has high sensitivity and specificity (Table 1).[10]

The basis of vascular access surveillance is to better the patency of the vascular access and to find and repair stenosis within the

Table 2. Clinical Indicators (Signs and Symptoms) Suggesting Underlying Clinically Significant Lesions During Access Monitoring.[10]

Procedures	Clinical Indicators
Physical examination or check	Ipsilateral extremity edema
	Alterations in the pulse, with a weak or resistant pulse, difficult to compress, in the area of stenosis
	Abnormal thrill (weak and/or discontinuous) with only a systolic component in the region of stenosis
	Abnormal bruit (high pitched with a systolic component in the area of stenosis)
	Failure of the fistula to collapse when the arm is elevated (outflow stenosis) and lack of pulse augmentation (inflow stenosis)
	Excessive collapse of the venous segment upon arm elevation
Dialysis	Aspiration of clots
	New difficulty with cannulation when previously not a problem
	Inability to achieve the target dialysis blood flow
	Prolonged bleeding beyond usual for that patient from the needle puncture sites for 3 consecutive dialysis sessions
	Unexplained (>0.2 units) decrease in the delivered dialysis dose (Kt/V) on a constant dialysis prescription without prolongation of dialysis duration

vascular access. Clinical parameter connected with vascular access stenosis (Table 2) including indicators on physical examination, high arterial and venous pressures at the specified blood flow, impaired dialysis clearance without known cause, and exaggerate bleeding after needle.withdrawal. Surveillance procedures, with specialized equipment, have been considered effectively to find AVF stenosis before the grown of a clinical indicator.[10]

When routine monitoring suggested a clinically important AVF stenosis, the diagnostic approach is required to investigate underlying lesion (i.e., venous outflow, anastomosis, arterial inflow,). DUS can be helpful to examine vascular access from arterial.anastomosis to.peripheral venous section and help deciding the causes of thrombotic flow-related complication. Percutaneous arteriography and venography can surely image from the anastomosis of AVcaccess to the heartaor entire AV access circuit.[10]

3.4 Upper Extremity DUS for evaluation of AVF dysfunction

In dysfunction of hemodialysis vascular access, decreased blood flow in main finding. DUS evaluation of AVF was performed to detect stenosis, flow limitation within AVF, and progression of thrombosis.

First evaluation with DUS is using greyscale imaging to measure diameter of fistula and stenosis. Significant stenosis is defined as narrowing of lumen.>50% compared with normal.vascular segments situated upstream from stenosis segment. Continue with color andaspectral doppler image in long axis plane, peak systolic velocity (PSV)aat anastomose is compared withaPSV that was taken in feeding artery 2cm upstream from anastomose. Ratio of PSV taken form anastomose and artery 2 cm upstream, above 3:1 was proposed as present of stenosis of more than 50%. A study using PSV above 375cm/s has sensitivity of 96% and specificity 76% to detect stenosis over than 50% in AVF. However, because sharp angulation of venous origin at anastomosis, that might increase PSV and simulate a stenosis, any stenosis found in anastomosis is advisable to confirm with grayscale imaging. There are findings suggested although stenosis is demonstrated, blood flow of AVF may be sufficient and still can be used for hemodialysis. Beside from anastomosis area, any visible narrowing of draining vein found on grayscale image or area of color aliasingiwithin the vein may require further assessment with velocity measurements by spectral Doppler imaging. The PSV at the narrowingivein is compared with the PSV of the vein 2 cm upstream (caudal). PSV ratio of a draining vein compared with PSV of vein 2cm upstream above 2:1 is proposed as sign of stenosis equal or greater than 50%. An assessment of the subclavian vein and ipsilateral internal jugular vein with spectral Doppler waveforms can detect signs of central stenosis. Central stenosis may be exist even with high flow in vascular access, lead to arm swelling. Multiple abnormalities can be found in a single dysfunctional vascular access.[11,12]

3.5 Treatment of Clinically Significant AV Access Stenosis

If there was thrombosis occurred or imminent, suggested from findings done in monitoring or surveillance, angiographic evaluation is usually recommended. Referral for urgent angiographic can be done if access thrombosis is found. Contraindications of angiographic procedure are infected access, pulmonary hypertension, surgical revision less than 30 days before referral, and presence of right to left shunt.[9]

Endovascular treatment of AVF stenosis is both safe and effective. When performed in dedicated center, has high success rates and low complication rates,aand has better of primary and secondary patency rate. The Society of Interventional Radiology (SIR) and Kidney Disease Outcomes Quality Initiative (K-DOQI) have guidelines in angiography procedure for acceptable success and patency rates in AVF. Stenosis is regarded as significant if there is more than 50% stenosis of diameter vessel, anatomical success is determined when there are less than 30% residual stenosis, and functional success is decided if there is success using the AVF for HD, or the AVF is mature by DUS examination.[13]

Based on the available evidence, there is an algorithm attempt to define practical factors of each individual technology. Figure 4 outlines the primary steps for salvage management of dysfunctional or thrombosed AVF access using percutaneous intervention. Percutaneous catheteradirected thrombolysis, and thrombectomy with the Angiojet oraother catheters, is management of choice for re-define flow in AVF thrombosis. In case of patent but failing circuits, after blood flow has been successfully restored, any unmasked oraidentified AVF stenosis need to be attend to repair functional adequacy of hemodialysis.[14,15]

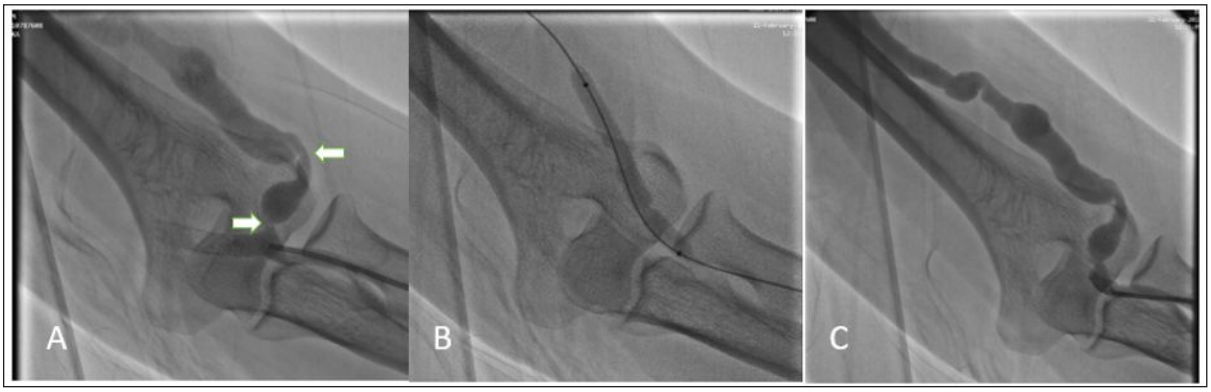

Figure 1. (A-C). A 64-year-old man with stenosis of the arteriovenous fistula demonstrated on venogram followed by balloon angioplasty. Venogram (A) shows mild stenosis (white arrow) of the arteriovenous. The sequential ballon angioplasty of the stenotic arteriovenous fistula is seen (B). Venogram (C) shows good restoration and flow across the lumen.

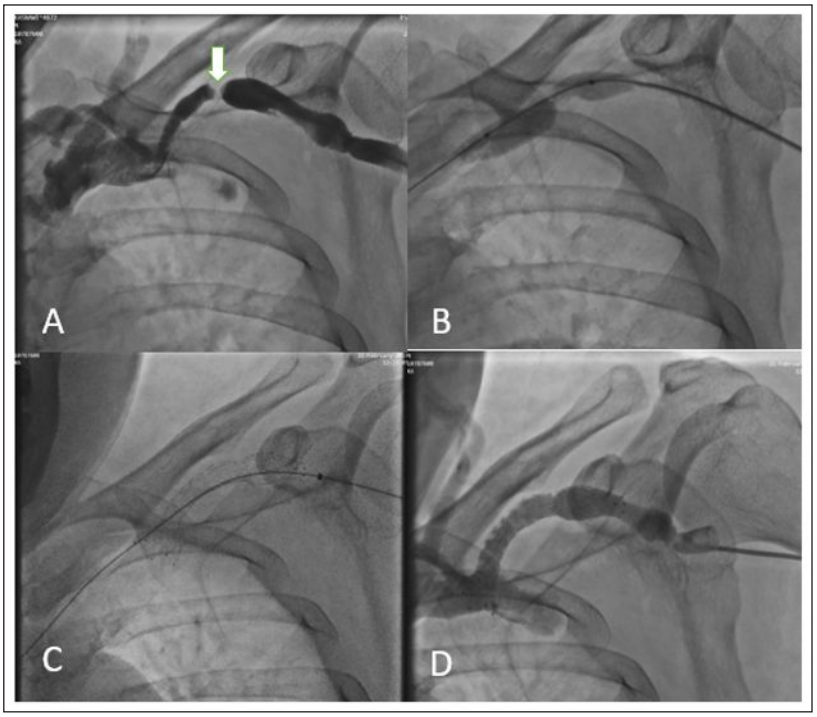

Figure 2. (A-D). A 64-year-old man with cephalic venous stenosis demonstrated on venogram. He underwent successful angioplasty and stenting. Venogram (A) shows severe stenosis (white arrow). The subsequent venogram (B) shows sequential ballon plasty is seen. The stent is seen deployed in of the stenotic cephalic vein (C). Venogram (D) shows the restoration of the lumen.

3.6 Management of Antithrombotic after Venous Stenting

There is still no consensus or guideline for management therapy of antithrombotic after venous stent placement to prevent stent thrombosis (ST) or in stent restenosis (ISR). In the post procedural setting, anticoagulant and/or antiplatelet are used to reduced the ST/ISR and recurrent stent thrombosis. There is wide variability of prescribing pattern in choosing antithrombotic regimens and the duration of therapy. There is possible benefit of triple therapy compared to antiplatelet or dual antiplatelet alone in lowering ST/ISR rate, although the comparison of bleeding risk between these treatments is not yet been investigate.

Application of anticoagulant practice in this setting was adopted from experience in managing venous thromboembolism with tendency to choose low molecular weight heparin and vitamin K antagonist. The practice ofaantiplatelet agents iseextrapolated from experience with implantation of arterial stents. Nevertheless, there is difference in underlying mechanism of luminal stenosis that occurs in venous stent and arterial stent. Stenosis of venous stents occurs in low flow and low shear systems, while stenosis of arterial stents is in high flow and high shear systems.[16]

To date there still no guidelines consensus to regulate use of anticoagulation after venous stenting. However, a recent study showed a consensus that the use anticoagulation is prefer for the first 6–12 months post venous stenting. For those who have history of multiple deep venous thromboses, a lifelong anticoagulation is recommended. For practice considering use of anticoagulation and antiplatelet therapy after venous stenting was based of experience with arterial stenting. As

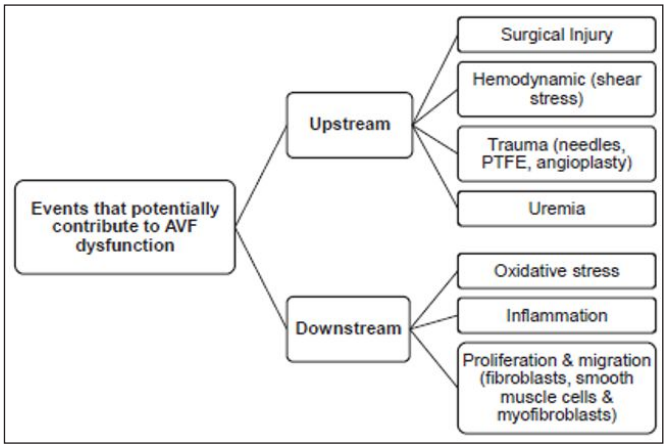

Figure 3. Upstream and downstream events as causes of intimal hyperplasia development proposed by Roy-Chaudhury et al. Upstream factors include comorbid conditions, surgical trauma, endothelial dysfunction, inflammation, and abnormal flow conditions after anastomosis. Downstream factors are secondary to upstream events and mostly include biological events reflecting the adaptive, and maladaptive, response of the vein to injury and new flow conditions.[7] Abbreviations: AVF, arteriovenous fistula; PTFE, polytetrafluoroethylene.

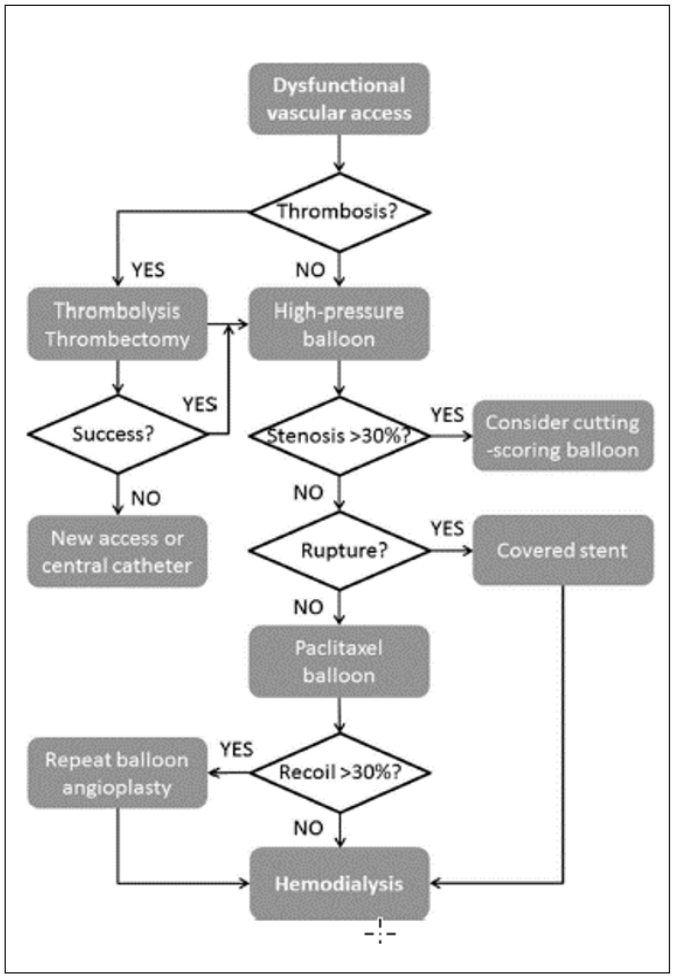

Figure 4. Proposed treatment algorithm.[15]

previously described, vessel characteristic and flow hemodynamics difference between vein and arterial systems, are factors that distinguish underlying pathophysiology.

A retrospective study showed better stent patency in patient take anticoagulant along with antiplatelet versus anticoagulation alone. Another retrospective study, measures effectiveness of triple therapy (anticoagulant and DAPT) versus DAPT only, exhibit fewer rate of ST/ISR in triple therapy group, with similar major bleeding events between these groups.[17]

4. Conclusion

In treating hemodialysis patient with AVF dysfunction, literature strongly support percutaneous salvage over surgery as preferable treatment. The advantages of percutaneous intervention are minor discomfort, immediate post-operative use of the AVF, lower infection rates, and reduced operating times and days in the hospital. AVF dysfunction is still prevalent is patient undergone salvage procedure, although several differential percutaneous intervention approach have already been established.

5. Declarations

5.1. Ethics Approval and Consent to participate
This study was approved by local Institutional Review Board, and all participants have provided written informed consent prior to involve in the study.

5.2. Consent for publication
Not applicable.

5.3. Availability of data and materials
Data used in our study were presented in the main text.

5.4. Competing interests
Not applicable.

5.5. Funding source
Not applicable.

5.6. Authors contributions
Idea/concept: SW. Design: DW. Control/supervision: NK, SW, AR. Data collection/processing: SW. Extraction/Analysis/interpretation: SW, NK, SW, AR. Literature review: NK, SW, AR. Writing the article: SW, NK, SW, AR. Critical review: NK, SW, AR. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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